EXHIBIT 4

REDACTED

Online Bid Prediction

Status: Proposal (evaluated via offline simulations)

[redacted]

[redacted]@ (DRX Quality)

[redacted]@, [redacted]@, [redacted]@[redacted]

Feb 2017

Background

Predicting bid responses from RTB buyers is a fundamental problem that has applications in many areas including Reserve Price Optimization (RPO) and [redacted]

In the context of RPO the key goal is to exploit the gap between the winning bid and the transaction price by inserting a (higher) reserve price between the two thereby inducing the winner to spend more. The challenge lies in predicting the per-buyer reserve price for each query. While the current RPO model generates [redacted], analysis indicates that [redacted] In fact, as can be seen from the analysis there are [redacted].

Customizing Models [redacted]

One of the main motivations of this work is [redacted]

[redacted]

Additionally [redacted]

[redacted]

To summarize, [redacted]

Understanding [redacted]

The [redacted]

[redacted]

Comment [1]: Can you say approximately by how much?

Comment [2]: I can run a query to get the actual numbers but here is a illustration: https[redacted]

Comment [3]: [redacted]

Comment [4]: Right, are these representing real traffic? If not, [redacted]

Comment [5]: Yes. [redacted]

Comment [6]: Oh, sorry, [redacted]

Comment [7]: I had also analyzed the [redacted]

We analyzed [redacted]

Moreover we also observed that [redacted]

[redacted]

[redacted]

Summarizing the above observations, we see that [redacted]

Comment [8]: Just to clarify: While I really like the idea and think that it's worth pursuing, it's important to recognize [redacted]

Comment [9]: There are several options here: 1. [redacted]

Comment [10]: Yes, I think you're right that there absolutely are options, such as the ones you mention, so I'm not _that_ concerned. :) Just wanted to bring it up.

Comment [11]: [redacted]

Comment [12]: I plan to spend some cycles over the next few months to think through the RPO story for GDN. [redacted]

Comment [13]: But if we want to move GDN to RPO, [redacted]

Comment [14]: I think there's a bit of a semantic shift in what 'RPO' means for [redacted] vs how we think about it here.

[redacted]

Online Bid Prediction Framework